

## Claims

- 1 1. An electronic system, comprising a single device having a light emitting portion and a  
2 magnetically sensitive portion, wherein said magnetically sensitive portion is for  
3 modulating light emission from the light emitting portion.
- 1 2. An electronic system, as recited in claim 1, wherein said device is for converting a  
2 magnetic digital signal directly into an optical digital signal.
- 1 3. An electronic system, as recited in claim 2, wherein said system is for converting said  
2 magnetic digital signal to both an electrical digital signal and into said optical digital  
3 signal, wherein either or both of said signals can be provided as a device output.
- 1 4. An electronic system, as recited in claim 1, wherein said magnetically sensitive  
2 portion comprises a magnetically permeable material.
- 1 5. An electronic system, as recited in claim 1, wherein said device comprises a three-  
2 terminal light-emitting transistor, said transistor comprising an emitter, a base, and a  
3 collector, wherein said light is emitted from said collector.
- 1 6. An electronic system, as recited in claim 5, wherein said base comprises said  
2 magnetically sensitive portion for receiving a digital magnetic control signal, wherein  
3 said magnetically sensitive portion comprises a magnetic switch, wherein switch  
4 position is determined by said digital magnetic control signal, wherein a first intensity  
5 of light is emitted in a first switch position and a second intensity of light is emitted in  
6 a second switch position wherein said first intensity is greater than said second  
7 intensity.
- 1 7. An electronic system, as recited in claim 5, wherein said transistor comprises ballistic  
2 spin filtering to spin polarize and analyze electrons for operation of said switch.

- 1 8. An electronic system, as recited in claim 7, wherein said transistor comprises a pair of  
2 magnetically permeable layers, wherein when said magnetically permeable layers are  
3 aligned said spin polarized electrons penetrate and when anti-aligned, said spin  
4 polarized electrons are attenuated.
- 1 9. An electronic system, as recited in claim 8, wherein said magnetically permeable  
2 layers are both located in said base.
- 1 10. An electronic system, as recited in claim 8, wherein one of said pair of magnetically  
2 permeable layers is located in said base and one of said pair of magnetically permeable  
3 layers is located in said emitter.
- 1 11. An electronic system, as recited in claim 5, wherein said emitter is tunnel coupled to  
2 said base across an insulator.
- 1 12. An electronic system, as recited in claim 5, wherein said device comprises a buried  
2 quantum well within a semiconductor collector, wherein said quantum well is formed  
3 of a quantum well material having a lower band gap than adjacent material.
- 1 13. An electronic system, as recited in claim 12, wherein said material having a lower  
2 band gap has a direct transition for more efficient generation of light in said quantum  
3 well.
- 1 14. An electronic system, as recited in claim 12, wherein said semiconductor collector  
2 further comprises a Schottky contact region.
- 1 15. An electronic system, as recited in claim 14, wherein said semiconductor collector  
2 further comprises an n type Schottky contact region, an undoped quantum well region,  
3 and a p type substrate layer heterostructure.
- 1 16. An electronic system, as recited in claim 12, wherein said light emitted by said device  
2 comprises photons having an energy approximately equal to the band gap of said  
3 quantum well material.

- 1 17. An electronic system, as recited in claim 5, wherein said emitter is capable of  
2 providing ballistic electrons across said base to said collector when an emitter-base  
3 bias is provided with a potential exceeding a collector-base energy barrier.
- 1 18. An electronic system, as recited in claim 17, wherein said collector-base energy  
2 barrier comprises a Schottky barrier.
- 1 19. An electronic system, as recited in claim 5, wherein said device comprises a spin  
2 valve transistor having a base-collector barrier, a source for complementary carriers,  
3 and a place for recombining to generate said photons.
- 1 20. An electronic system, as recited in claim 19, wherein said base collector barrier  
2 comprises a Schottky barrier, said source for complementary carriers comprises a p-  
3 type substrate layer, and said place for recombining comprises a quantum well.
- 1 21. An electronic system, as recited in claim 19, wherein said spin valve transistor  
2 includes a base having a first magnetically permeable layer and a second magnetically  
3 permeable layer.
- 1 22. An electronic system, as recited in claim 21, wherein said first magnetically  
2 permeable layer is ferromagnetic.
- 1 23. An electronic system, as recited in claim 21, wherein said second ferromagnetic layer  
2 has a lower coercive field level than said first ferromagnetic layer so said second layer  
3 can be switched without switching said first layer to provide for turning on and  
4 turning off current in said device with an intermediate level magnetic field.
- 1 24. An electronic system, as recited in claim 23, wherein said spin valve transistor  
2 includes a base-collector contact comprising a Schottky barrier diode having a  
3 Schottky barrier height.
- 1 25. An electronic system, as recited in claim 24, wherein said Schottky barrier diode  
2 provides that only ballistic electrons having energy at least equal to said Schottky  
3 barrier height are injected into said collector.

- 1 26. An electronic system, as recited in claim 25, wherein said transistor comprises a  
2 variable emitter-base voltage and an independently variable collector-base voltage.
- 1 27. An electronic system, as recited in claim 26, wherein said transistor emits photons  
2 only when said emitter-base voltage exceeds a threshold approximately equal to the  
3 said Schottky barrier height.
- 1 28. An electronic system, as recited in claim 26, wherein said transistor emits photons  
2 only when said collector-base voltage exceeds a threshold approximately equal to the  
3 difference between said bandgap and said Schottky barrier height.
- 1 29. An electronic system, as recited in claim 28, further comprising a first power supply  
2 for providing an electrical potential across a collector-base junction of said transistor,  
3 wherein when said electrons are injected into said collector over a Schottky barrier  
4 with an energy at least equal to energy of said Schottky barrier, the combination of  
5 this electron energy and said potential energy provided by said first power supply  
6 provides said electrons with enough potential energy to generate photons from  
7 recombination in said quantum well.
- 1 30. An electronic system, as recited in claim 29, further comprising a second power  
2 supply for providing an electrical potential across an emitter-base junction of said  
3 transistor, wherein said emitter provides ballistic electrons at an energy exceeding  
4 said Schottky barrier when sufficient emitter-base potential is provided.
- 1 31. An electronic system, as recited in claim 5, wherein said collector comprises an n type  
2 region and a p type region and a region-there-between, wherein said region-there-  
3 between has a lower band gap than either said n type region or said p type region so as  
4 to trap both electrons and holes for facilitating recombination and photon generation.
- 1 32. An electronic system, as recited in claim 31, wherein said region-there-between is  
2 undoped or lightly doped.

- 1 33. An electronic system, as recited in claim 5, wherein emitter-base contact comprises a  
2 second Schottky diode.
- 1 34. An electronic system, as recited in claim 1, wherein said device comprises a two-  
2 terminal light-emitting transistor, said two terminal transistor comprising a base and a  
3 collector, wherein said light is emitted from said collector, wherein said base of said  
4 two terminal transistor is exposed for receiving sub-band gap photons to provide  
5 internal photo-emission of charges in said base.
- 1 35. An electronic system, as recited in claim 1, further comprising a magnetic read head  
2 that converts magnetic information into an optical signal.
- 1 36. An electronic system, as recited in claim 1, further comprising an array of said  
2 devices for storing information and for converting said stored information into optical  
3 signals.
- 1 37. An electronic system, as recited in claim 1, wherein said single device further  
2 comprises amplification.
- 1 38. An electronic system, as recited in claim 1, further comprising a power supply,  
2 wherein said single device comprises a collector and a base, wherein said power  
3 supply is connected for providing a collector-base voltage sufficient to provide  
secondary electrons by impact ionization to provide amplification.

- 1 39. An electronic system, comprising a hot electron metal base transistor having a  
2 quantum well for facilitating light emission.
- 1 40. An electronic system, as recited in claim 39, wherein said transistor comprises a pair  
2 of ferromagnetic layers wherein one of said layers can have its magnetization  
3 orientation switched independently of the other layer to facilitate magnetic switching.
- 1 41. An electronic system, as recited in claim 39, wherein a first intensity of light is  
2 emitted in a first magnetic switch position and a second intensity of light is emitted in  
3 a second magnetic switch position, wherein said first intensity is greater than said  
4 second intensity.
- 1 42. An electronic system, as recited in claim 39, wherein said transistor comprises  
2 ballistic spin filtering to spin polarize and analyze said charges for operation of said  
3 switch.
- 1 43. An electronic system, as recited in claim 39, wherein said metal base comprises a  
2 ferromagnetic layer.
- 1 44. An electronic system, as recited in claim 43, wherein said metal base comprises a pair  
2 of magnetically permeable layers, wherein when said magnetically permeable layers  
3 are aligned said spin polarized charges penetrate and when anti-aligned, said spin  
4 polarized charges are attenuated.
- 1 45. An electronic system, as recited in claim 39, further comprising a magnetic read head  
2 that converts magnetic information into an optical signal.
- 1 46. An electronic system, as recited in claim 39, further comprising an array of said  
2 devices for storing information and for converting said stored information into optical  
3 signals.
- 1 47. An electronic system, as recited in claim 39, wherein said single device further  
2 comprises amplification.

1 48. An electronic system, as recited in claim 39, wherein said transistor comprises a  
2 collector, a base, and a power supply for providing a collector-base voltage sufficient  
3 to provide secondary electrons by impact ionization to provide amplification.

- 1       49. An electronic system comprising a magnetic storage medium and a read head,  
2       wherein said read head includes a single device transducer for receiving a magnetic  
3       signal from said magnetic storage medium and converting said magnetic signal into  
4       an optical signal.
- 1       50. An electronic system, as recited in claim 49, further comprising an optical wave  
2       guide, wherein said read head provides said optical output signal to said optical wave  
3       guide.



- 1 51. An electronic system, comprising an array of memory devices for receiving magnetic  
2 information and for converting said magnetic information into an optical signal.
- 1 52. An electronic system, as recited in claim 51, wherein said array of memory devices  
2 comprises an array of single device memory cells, wherein each said single device  
3 memory cell of said array stores said magnetic information and converts said  
4 magnetic information into an optical signal.
- 1 53. An electronic system, as recited in claim 51, further comprising a magnetic  
2 read/optical write display in which all data in said array is converted to said optical  
3 signal at once.
- 1 54. An electronic system, as recited in claim 51, comprising a magnetic read/optical write  
2 random access memory in which data can be read one cell at a time.